

## (12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization International Bureau



(43) International Publication Date  
15 January 2004 (15.01.2004)

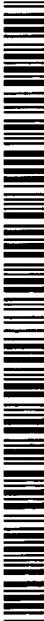
PCT

(10) International Publication Number  
**WO 2004/005731 A1**

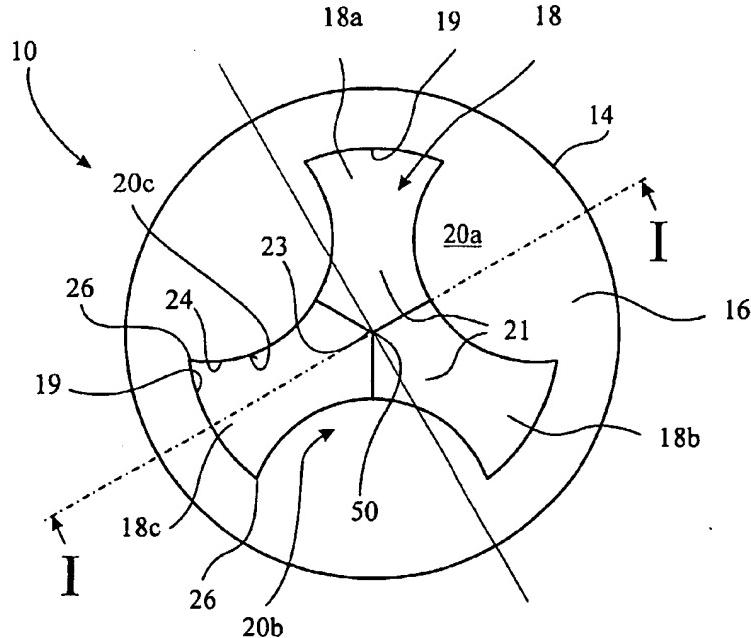
- (51) International Patent Classification<sup>7</sup>: F16B 23/00, B25B 15/00 Properties, Popular Nurseries, Main Street, Swallownest, Sheffield S26 4TZ (GB).
- (21) International Application Number: PCT/GB2003/002740 (71) Applicant and
- (22) International Filing Date: 27 June 2003 (27.06.2003) (72) Inventor: WALKER, Eric [GB/GB]; t/a Walker Properties, Popular Nurseries, Main Street, Swallownest, Sheffield S26 4TZ (GB).
- (25) Filing Language: English (74) Agent: LUNT, Mark, George, Francis; Harrison Goddard Foote, Fountain Precinct, Leopold Street, Sheffield S1 2QD (GB).
- (26) Publication Language: English (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (30) Priority Data: 0215376.5 4 July 2002 (04.07.2002) GB (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,

*[Continued on next page]*

(54) Title: SCREW AND DRIVER THEREFOR



WO 2004/005731 A1



(57) Abstract: A screw (10) has a threaded shank (12) and a head (14). The head has a recess (18) that comprises three lobes (18a, b, c). Each lobe is separated by a curved drive flange (20a, b, c). A driver (100) has a drive tip (114) that fits the recess of the screw.



SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM,  
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**

— *with international search report*

**Declaration under Rule 4.17:**

— *of inventorship (Rule 4.17(iv)) for US only*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## SCREW AND DRIVER THEREFOR

The present invention relates to screws and drivers therefor, and particularly woodscrews having a 5 countersunk head.

Traditionally, countersunk woodscrews are provided with a straight slot drive recess, but various forms of crossed slots, culminating in Philips® and Posidriv® 10 forms of drive recess, have been developed.

However, whatever form of driver/recess is employed, an axial pressure is almost invariably required (and a pressure, moreover, that increases with increasing torque 15 applied) in order to counter the tendency of drivers to "cam-out" of engagement with the screw recess.

Furthermore, as screws get larger it is usually necessary to increase the dimensions of the recess so 20 that greater torque can be transmitted. However, this usually involves a different and bigger driving tool.

FR-A-2585609 discloses a drive system comprising a driving and a driven element each having a circular end 25 face with upstanding sectors the edges of which are undercut. Consequently, when the driving and driven element are engaged face to face with their respective sectors interdigitating, the undercut edges transmit rotary drive between them with no cam-out. However, 30 forming undercut edges on the head of a screw is problematic.

SU-A-438814 discloses a screw with a triangular recess, and a driver therefor. The recess appears to be 35 undercut so that, after the driver has been inserted and

turned through a small angle, undercut ledges on the driver engage with the recess undercuts to prevent disengagement. Again, forming undercut edges is problematic.

5

It is an object of the present invention to provide a screw, and driver therefor, wherein the screw has a recess form that reduces the tendency of the driver to cam-out when torque is applied. Moreover, the 10 arrangement should be simple, and have the capacity to permit several sizes of screw to be driven by the same driver.

In accordance with a first aspect of the present 15 invention, there is provided a screw having a driving recess in a top face of its head, the recess comprising at least two recess-lobes evenly spaced around a longitudinal axis of the screw, and driving flanges joining adjacent lobes, wherein each flange in transverse 20 section is an arc convex with respect to the longitudinal axis, has sides which are parallel said longitudinal axis and has a tangent which is radial with respect to said longitudinal axis, the floor of said recess-lobes being inwardly inclined from their junctions with said top face 25 towards said longitudinal axis.

Although two recess-lobes, and four or more recess-lobes are within the ambit of the present invention, three is the preferred number. This facilitates finding 30 the correct orientation of a driver for the screw since the maximum angle through which they may be misaligned with respect to one another is 60 degrees of rotation, as opposed to 90 degrees of rotation for a two-lobe recess. On the other hand, four-lobe recesses still have the 35 capacity for 45 degrees of misalignment, so that the

benefit in this respect of more recess-lobes diminishes with increasing number of them. However, three recess-lobes gives a preferred balance of material as between the driver and screw, as opposed to more than three 5 recess-lobes.

Preferably, the arc is substantially circular.

Preferably, said tangent is radial at a distance 10 from where the arc meets each lobe.

Preferably, the lobes are part-circular in section at their junctions with said top face, centred on the longitudinal axis.

15

Preferably, the centre of each arc is on a circle that is centred on the longitudinal axis, the radius of which circle is the same as or greater than the radius of the lobes, preferably the same.

20

Preferably, the radius of each arc is between 60 and 80% of the radius of the lobes, ideally about 67%.

25

Preferably, the profile of the recess reduces at a constant rate with increasing depth. The floor of the recess-lobes is inclined at angle of between 30 and 60 degrees, ideally about 45 degrees.

30

In another aspect, the present invention provides a driver for a screw defined above. A driver comprises a drive tip having at least two drive elements evenly spaced around a longitudinal axis of the driver, and scallops joining adjacent drive elements, wherein each scallop in transverse section is a concave arc that has 35 sides which are parallel said longitudinal axis, and has

a tangent which is substantially radial with respect to the longitudinal axis, front faces of said drive elements being inclined from a point coincident with said longitudinal axis.

5

The profile of the driver is obviously arranged to correspond with the profile of the screw. Preferably, three drive elements are provided.

10       For a large range of screws, it desirable to have several size ranges of the recess and respective driver, each size being suited for a small range of screw sizes. That is to say, the recess in each screw of the small range being substantially the same. However, it is  
15      possible to reduce the depth of the recess for smaller sizes in each range so that the radius of the circle containing the junctions of said recess-lobes and top face of the screw reduces correspondingly. Also, for larger screws in each range, the depth of each recess may  
20      be deeper so that said floor drops perpendicularly from said top face before inclining towards said longitudinal axis. Thus the same driver can be employed to drive a variety of different sizes of screw within each size range. The effect of the change in depth of the recess  
25      is to alter the area of driving surfaces of the recess available to the driver, a larger area being provided for larger screws.

30       The invention is further described hereinafter, by way of example, with reference to the accompanying drawings, in which:

35       Figures 1a and b are a top view and a side view (partly in section along the line I-I in Figure 1a) respectively of a countersunk woodscrew in accordance

with the present invention;

Figures 2a and b are similar views of a smaller screw in the same size range as that of Figure 1 (Figure 2b being partly in section along the line II-II in Figure 5 2a);

Figures 3a and b are similar views of a yet smaller screw in the same size range as that of Figure 1 (Figure 3b being partly in section along the line III-III in Figure 3a);

10 Figures 4a and b are similar views of a larger screw in the same size range as that of Figure 1 (Figure 4b being partly in section along the line IV-IV in Figure 4a);

15 Figures 5 a and b are and end view and a side view (in the direction of Arrow A in Figure 5a) of a driver for the screws of Figures 1 to 4;

Figure 6 is a top view of a different embodiment of screw in accordance with the present invention and having two lobe-recesses; and

20 Figure 7 is a top view of another different embodiment of screw in accordance with the present invention, having four lobe-recesses.

With reference to Figures 1a and b, a screw 10 is shown in accordance with the invention having a threaded shank 12 and a countersunk head 14. The head 14 is provided in its top face 16 with a driving recess 18. The recess 18 comprises 3 lobes 18a,b,c having edges 19 which are circular in section, centred on a longitudinal 30 axis 50 of the screw 10. Each lobe 18a,b,c is joined by a drive flange 20a,b,c.

The drive flanges 20a,b,c are each an arc of a circle, in section, tangents of which are radial with respect to the axis 50. The walls 24 of each drive

flange are parallel the axis 50. They are centred on points substantially coincident with the circle that includes the edges 19. In this event, at the points 26 at which the walls 24 meet the edges 19, they do so at an 5 acute angle so that the lobe-recess 18 between adjacent drive flanges 20 is swallowtail in form. The screw recess 18 can conveniently be referred to as a tri-arc recess.

10        Each lobe-recess 18a,b,c has a floor 21 which is flat and inclined from the junction 19 between the lobe-recess 18 and top face 16, inwardly and downwardly towards the longitudinal axis 50, where the floors of each lobe-recess meet at a point 23 coincident with the 15 axis 50.

Turning to Figures 5a and b, a driver 100 is shown having a hexagonal section shank 112 for fitting in a conventional socket to rotationally drive the driver 100 about its longitudinal axis 50'. On the end of the shank 20 112 is a driving tip 114. The tip 114 comprises 3 drive elements 118a,b,c. Between each drive element is a scallop 120a,b,c. In transverse section, each scallop is concave forming an arc of a circle. Similarly, the 25 external surface 119 of the drive element 118a,b,c lies on the arc of a circle centred on the axis 50'.

Each drive flange 118 has a flat front face 121, inclined from the side of the driving tip 114 to a point 30 123 coincident with the axis 50'.

Both the floors 21 and the faces 121 could have a different profile and could, for example, lie on the surface of a cone joining all three floors and faces.

The driving tip 114 is shaped to fit the recess 18 of the screw 10 so as to transmit drive from the driver 100 to the screw 10. Since the shape of the driver and recess is rotationally symmetrical, drive can be  
5 transmitted in either direction.

Both the recess and tip diminish in size with a cone angle  $\alpha$  of about 45 degrees, although sharper angles of about 60 degrees are possible.

10

By virtue of the curved face of the scallops 120 and the mating surfaces of the drive flanges 20, a particularly tight fit between them is achievable. The scalloped drive elements 118 grip the drive flanges 20 at  
15 their edges in the dovetail extremity of the lobe-recesses 18. Moreover, because the drive elements 118 can wedge between adjacent drive flanges 18, slipping of the driver in the recess is resisted.

20

While the driving flanges 20a,b,c are shown as a circular arc, it is feasible that they could have the form of a different arc, the primary feature being the dovetail arrangement of the lobe-recesses..

25

The relative dimensions of the recess 18 can be maintained in larger or smaller screws, a different driver being required for each change in overall dimensions. However, with the same relative dimensions, there is still opportunity to adjust the recess size  
30 depending on the size of screw.

Thus in Figures 2a and b, a smaller screw 10' is shown having a recess the same as that of Figure 1, but with less depth so that only the front tip of the driver  
35 100 engages the recess 18'. This can be taken still

further, as shown in Figures 3a and b where the recess 18" of screw 10" is even shallower. Clearly there is a reduction in drive surfaces available and the dovetail wedging feature is lost. However, with smaller screws 5 less torque is required. Nevertheless, a balance has to be struck between the desire, on the one hand, to reduce the number of drivers that are required to accommodate as wide a range of screws as possible, and, on the other, to improve cam-out resistance as much as possible. The 10 latter desire militates towards using a profile as shown in Figure 1 in each screw.

In the other direction, Figures 4a and b show a larger screw than that illustrated in Figure 1, but still 15 having the same recess. Except, here, the recess 18" of the screw 10" is set deeper into the head 14", so that floors 21" have a cylindrical section 21a (that is to say, perpendicular the top face 16"). This increases the area of the driving surfaces of the flanges 20" 20 available for contact by the drive elements 118 of the driver 100.

Finally, Figures 6 and 7 show two alternative arrangements that benefit, to a certain extent, from the 25 same advantages provided by the present invention, but which are not particularly preferred. In Figure 6, just two driving flanges 220a,b are provided, the floor 221 of the lobe-recesses 218 between them meeting at a line 223. In Figure 7, four lobe-recesses 418 and driving flanges 30 420 are provided. The floors 421 between the flanges meet at a four-edged point 423.

**CLAIMS**

1. A screw having a driving recess in a top face of its head, the recess comprising at least two recess-  
5 lobes evenly spaced around a longitudinal axis of the screw, and driving flanges joining adjacent lobes, wherein each flange in transverse section is an arc convex with respect to the longitudinal axis, has sides which are parallel said longitudinal axis and has a tangent which is radial with respect to said longitudinal axis, the floor of said recess-  
10 lobes being inwardly inclined from their junctions with said top face towards said longitudinal axis.
- 15 2. A screw as claimed in claim 1, in which said arc is substantially circular.
3. A screw as claimed in claim 1 or 2, in which said tangent is radial at a distance from where the arc  
20 meets each lobe.
4. A screw as claimed in any preceding claim, in which the lobes are part-circular in section at their junctions with said top face, centred on the  
25 longitudinal axis.
- 30 5. A screw as claimed in any preceding claim in which the centre of each arc is on a circle that is centred on the longitudinal axis, the radius of which circle is the same as or greater than the radius of the lobes, preferably the same.
- 35 6. A screw as claimed in claim 2 or in any of claims 3 to 5 when dependent on claim 2, in which the radius of each arc is between 60 and 80% of the radius of

the lobes, ideally about 67%.

7. A screw as claimed in any preceding claim, in which there are three of said recess-lobes.

5

8. A driver having a drive tip to fit the recess of a screw as defined in any of the preceding claims.

- 10 9. A driver comprising drive tip having at least two drive elements evenly spaced around a longitudinal axis of the driver, and scallops joining adjacent drive elements, wherein each scallop in transverse section is a concave arc that has sides which are parallel said longitudinal axis, and has a tangent which is substantially radial with respect to the longitudinal axis, front faces of said drive elements being inclined from a point coincident with said longitudinal axis.

- 15 10. A driver as claimed in claim 9, in which the cone angle of the reducing section of the tip is between 30 and 60 degrees, preferably about 45 degrees.

- 20 11. A driver as claimed in claim 9 or 10, in which there 25 are three drive elements.

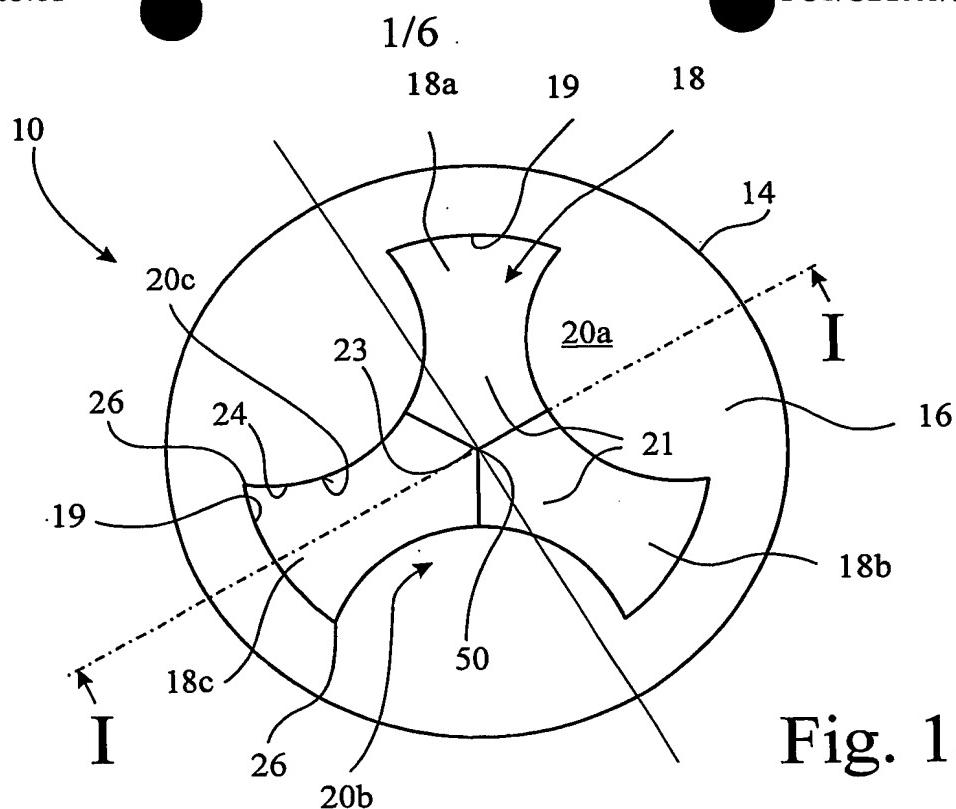


Fig. 1a

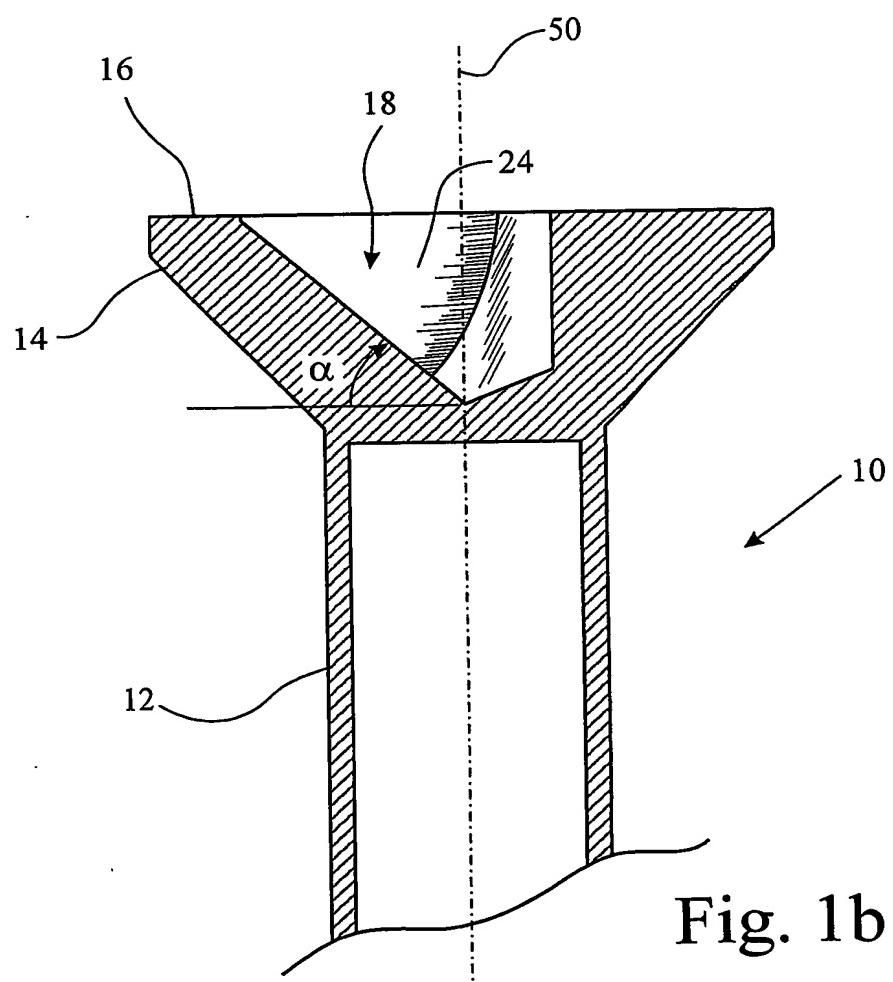
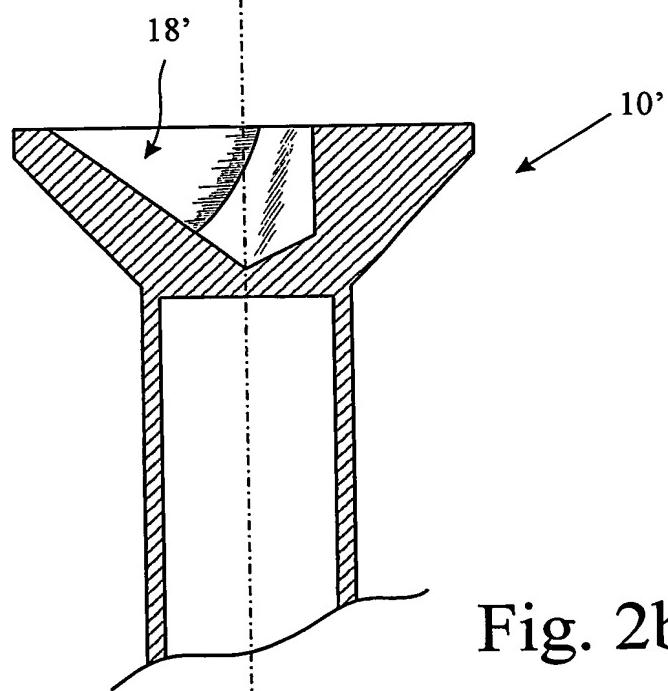
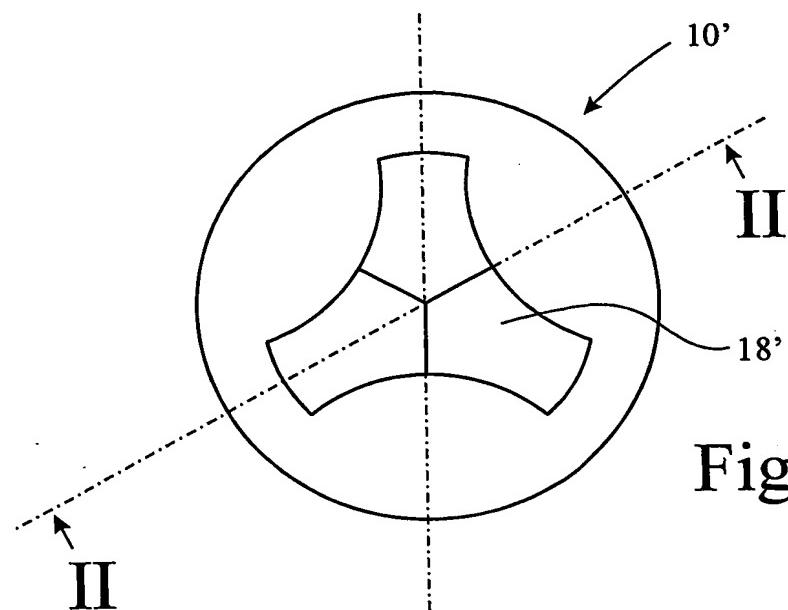


Fig. 1b

2/6



3/6

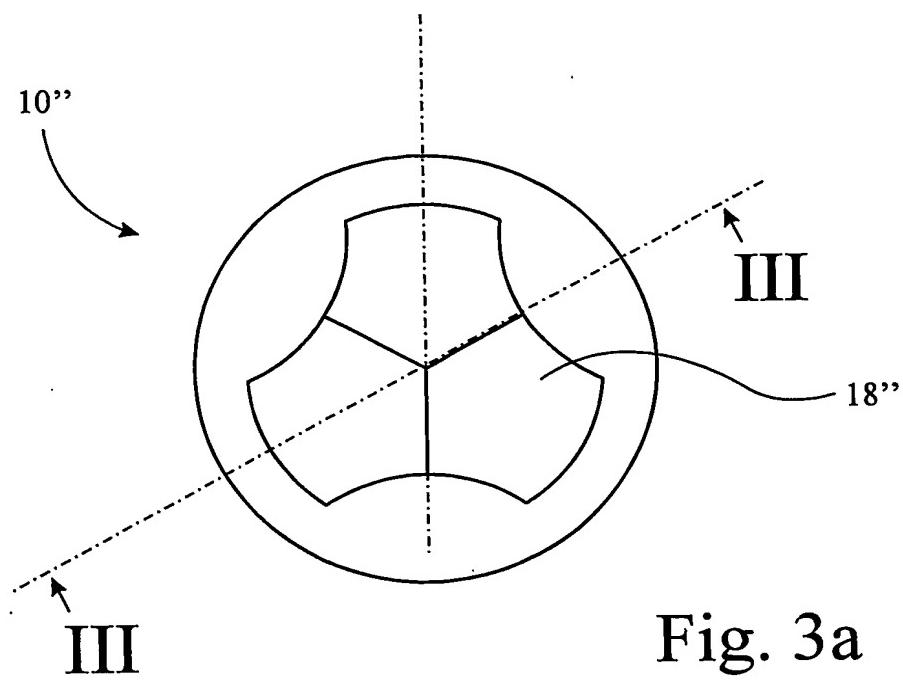


Fig. 3a

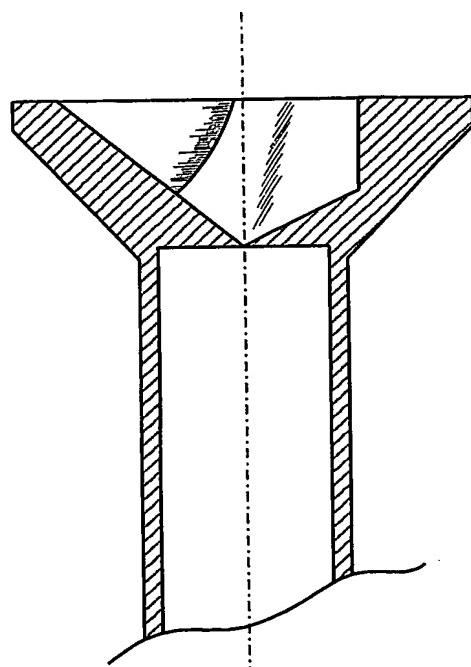


Fig. 3b

4/6

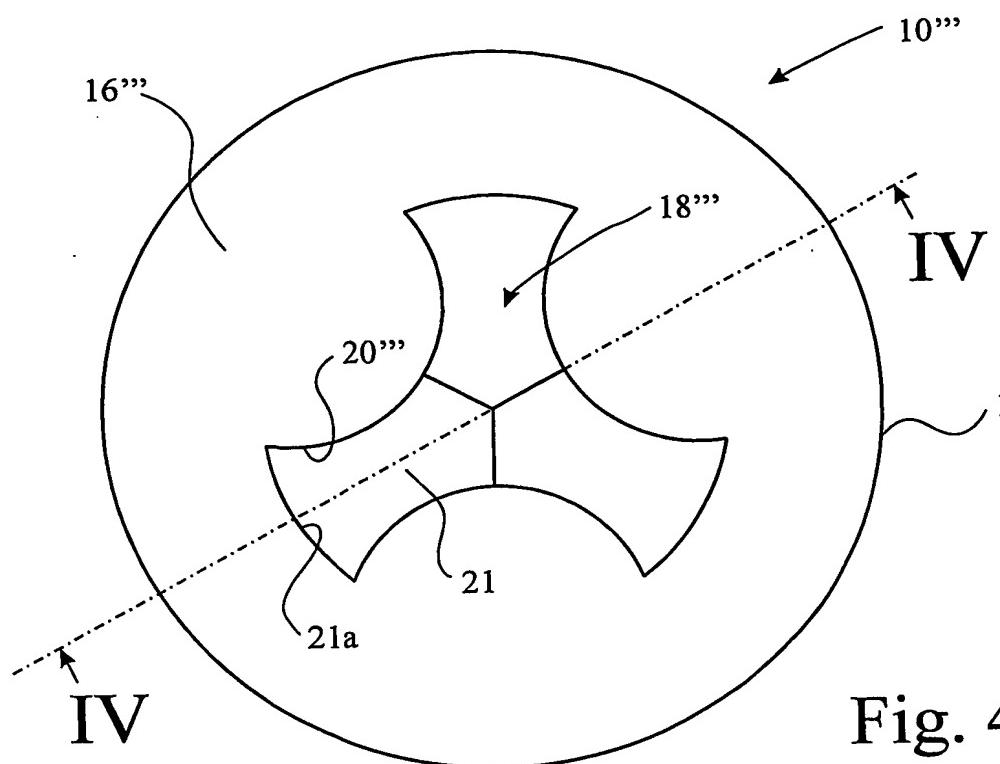


Fig. 4a

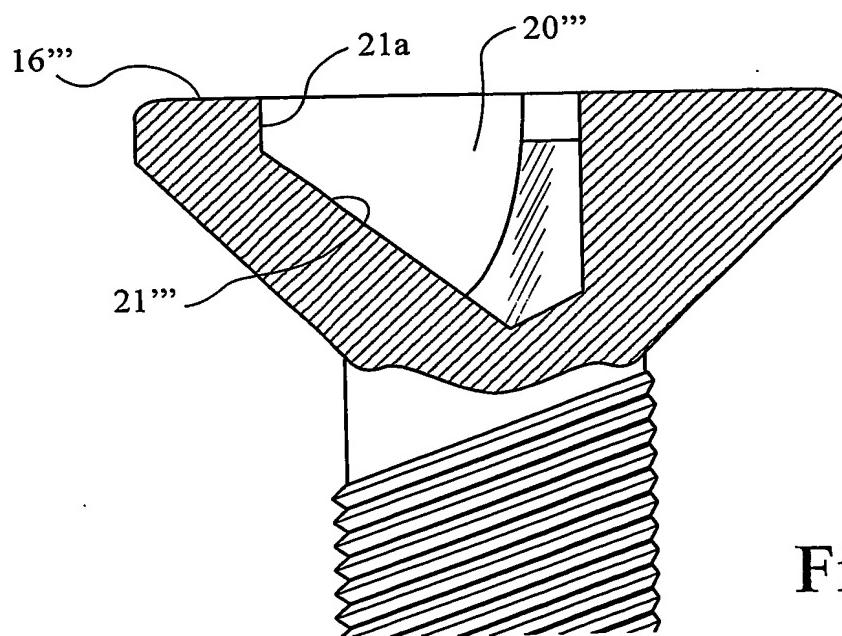


Fig. 4b

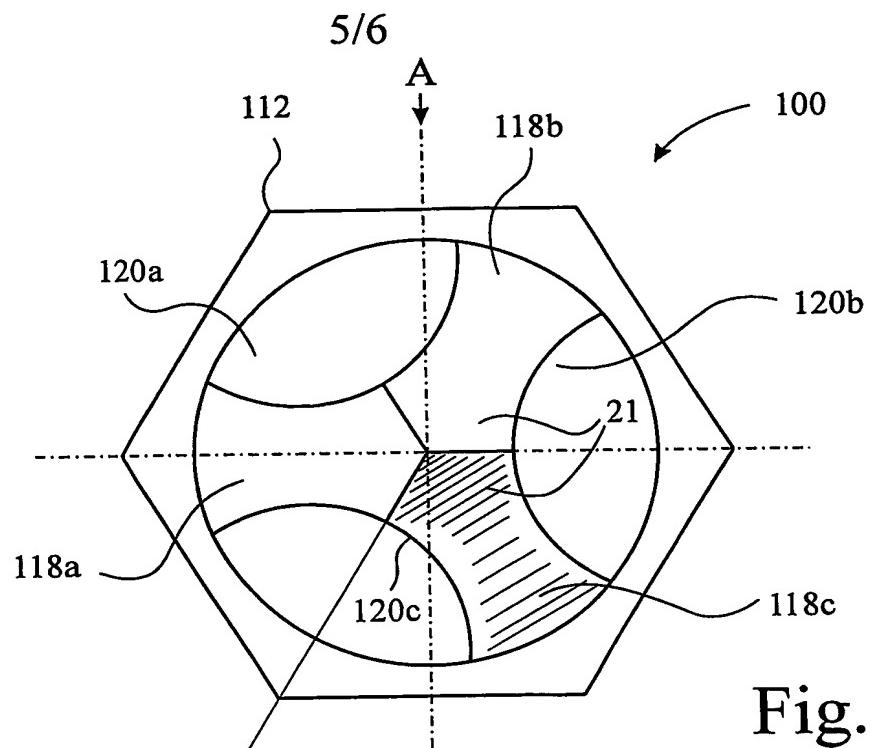


Fig. 5a

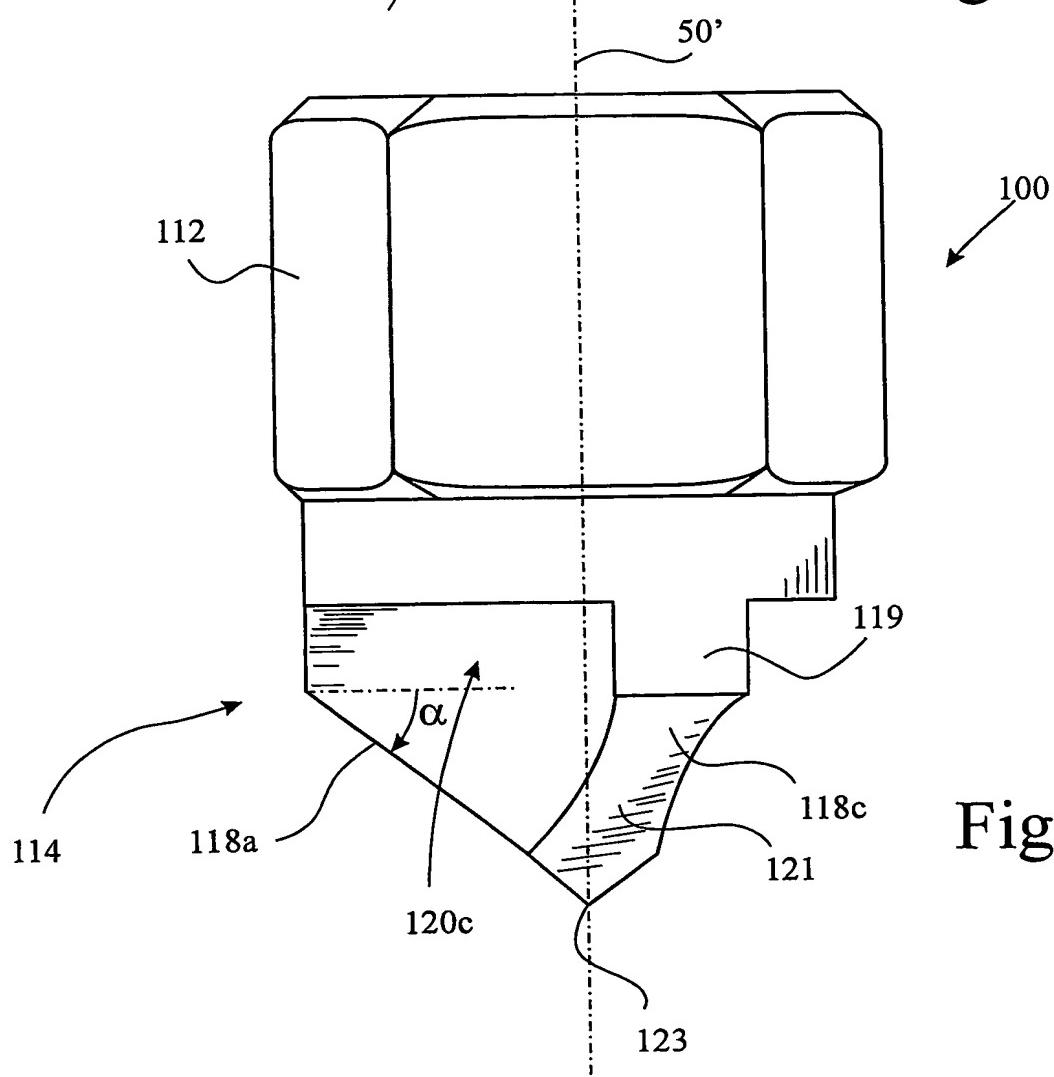


Fig. 5b

6/6

A

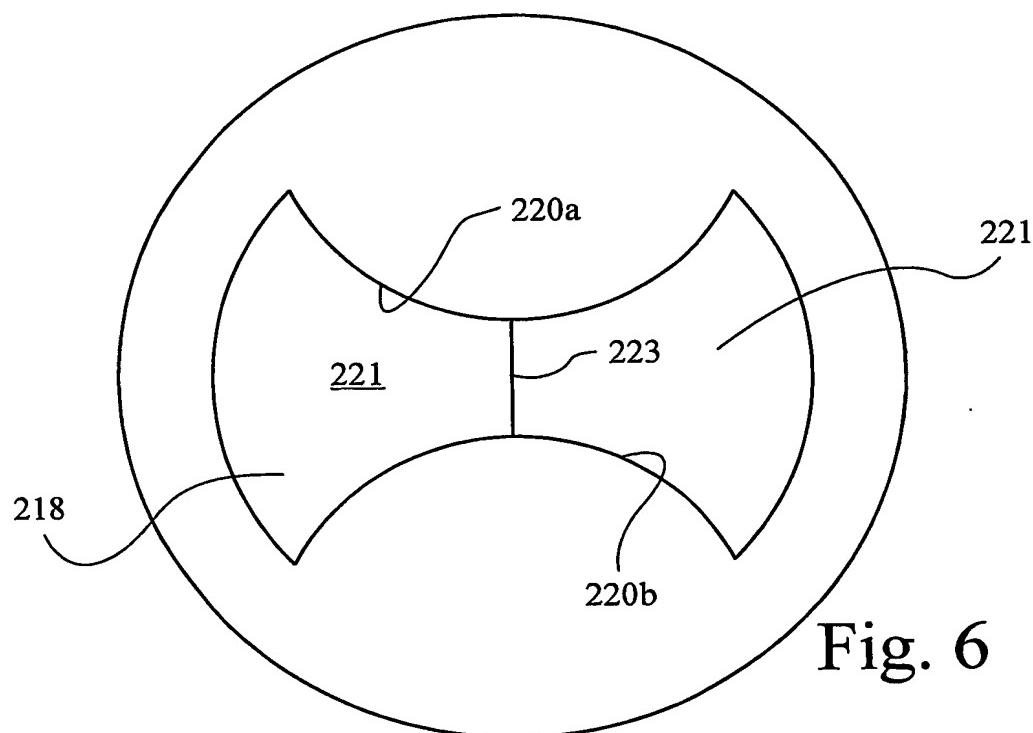


Fig. 6

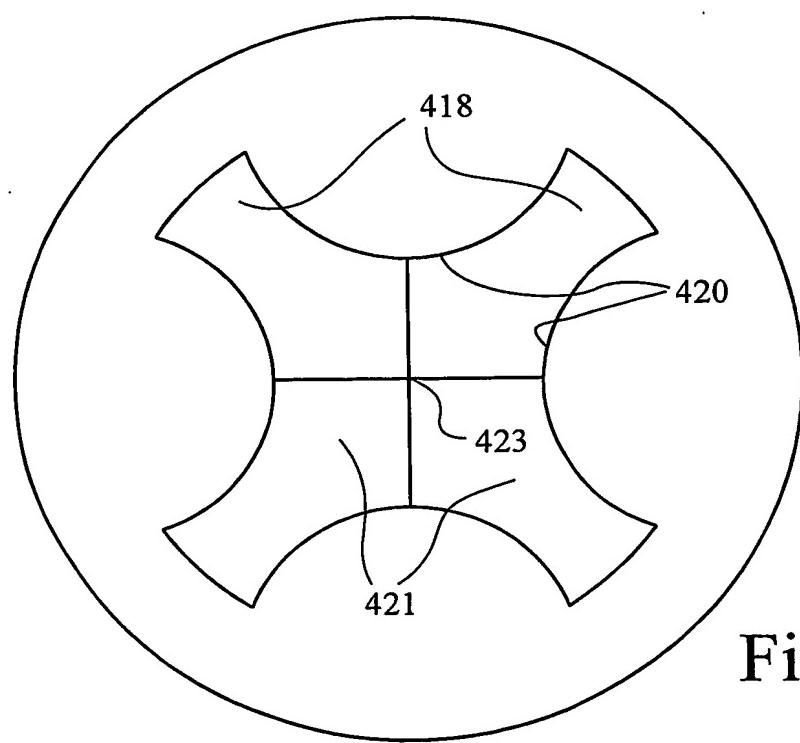


Fig. 7

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 03/02740

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC 7 F16B23/00 B25B15/00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
 IPC 7 F16B B25B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	AT 398 231 B (CVETKOVIC MIRKO) 25 October 1994 (1994-10-25) the whole document ---	1-3,5,7
A	GB 1 491 515 A (YAMAMOTO BYORA CO LTD) 9 November 1977 (1977-11-09) figures 1-11 claims 1,2 ---	1-11
A	WO 00 71301 A (WERNER HERMANN WERA WERKE ;HEINTZ STEFAN (DE); REUSCH ANDREAS (DE)) 30 November 2000 (2000-11-30) Abstract figures 1,2 -----	1-11

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

\* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*&\* document member of the same patent family

Date of the actual completion of the international search

8 September 2003

Date of mailing of the international search report

18/09/2003

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Huusom, C

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International Application No

PCT/GB 03/02740

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
AT 398231	B	25-10-1994	AT	113091 A		15-02-1994
GB 1491515	A	09-11-1977	DE HK	2451373 A1 43178 A		07-05-1975 11-08-1978
WO 0071301	A	30-11-2000	DE AU WO	19923855 A1 5071400 A 0071301 A1		04-01-2001 12-12-2000 30-11-2000